

PATENT ABSTRACTS OF JAPAN

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(54) RESISTOR AND MANUFACTURE THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To

improve a withstand voltage

characteristic in a resistor to be used

for current detection and potential

detection in an inverter circuit or the

like.

SOLUTION: Since a resistor 13

provided with an electrode 12 for

external connection and an electrode

12 for external connection so as to

be superimposed and a resistor 13

being provided with an intermediate

electrode 14 between the resistor 13

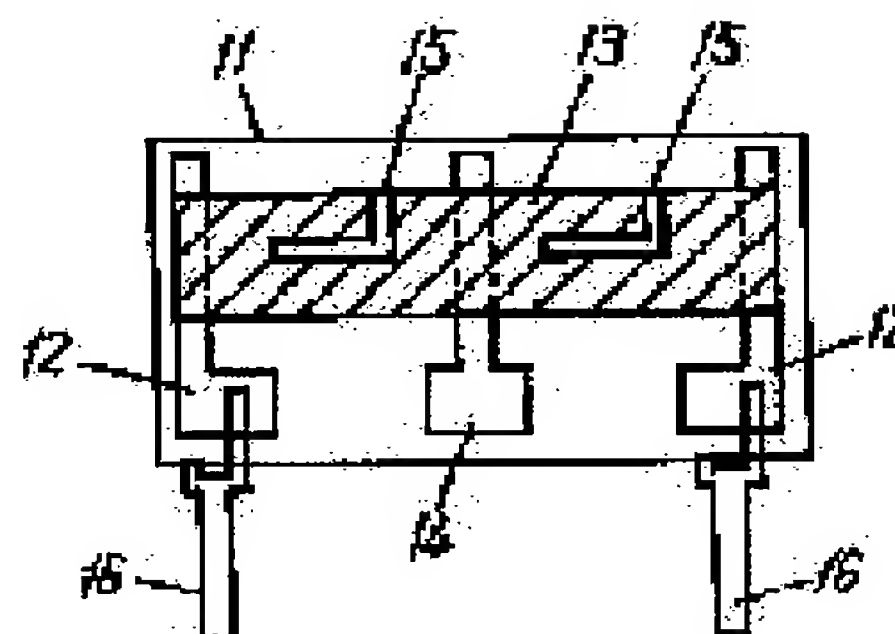
and the electrode 12 for external

connection and being connected to

the electrode 12 for external

connection and the intermediate

electrode 14 are almost in the same



shape besides being corrected almost to the same shape and almost to the same resistance value by trimming, a voltage applied to the resistor can be equally dispersed so as to effectively improve a withstand voltage characteristic.

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CLAIMS

[Claim(s)]

[Claim 1] An insulating substrate and the electrode for external connection electrically connected to the top face of this insulating substrate through the resistor, It has one or more bipolar electrodes prepared in said inter-electrode one for external connection, and the resistor prepared so that it might superimpose said inter-electrode one for external connection. Laser trimming of the part for the local area of said resistor classified between said electrode for external connection and bipolar electrode, and said bipolar electrode is carried out respectively, and it is a resistor with almost same configuration and resistance for the local area.

[Claim 2] The process which forms [the electrode for external connection, and this inter-electrode one for external connection] one or more bipolar electrodes in the top face of an insulating substrate with the same ingredient at coincidence, The process which forms the resistor prepared so that it might superimpose on said inter-electrode one for external connection, It is the manufacture approach of a resistor with a configuration and resistance consist of a process which carries out laser trimming of the part for the local area of said resistor classified between said electrode for external connection and bipolar electrode, and said bipolar electrode respectively, and almost same [a part for the local area of said resistor by which laser trimming was carried out].

[Claim 3] The manufacture approach of a resistor according to claim 2 of having the process which connects the electrode for external connection, and a bipolar electrode electrically with a lead terminal, and the process made lacking the lead terminal connected to the bipolar electrode among said lead terminals.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the resistor used for electrical-potential-difference detection and current detection by an inverter circuit etc., and its manufacture approach.

[0002]

[Description of the Prior Art] As a conventional resistor, what was indicated by the open technical report of the **** number 85-1906 of the Japan Institute of Invention and Innovation issue is known.

[0003] Drawing 5 is the front view of the conventional resistor. 1 is a substrate. 2 is the electrode for external connection prepared in the both ends of a substrate 1. 3 is the bipolar electrode prepared in substrate 1 top face between the electrodes 2 for external connection. 4 is the resistor prepared between the electrodes 2 for external connection. 5 is the trimming slot of the uniform amount of cuts formed in the resistor 4.

[0004]

[Problem(s) to be Solved by the Invention] However, in the above resistors, when it did not become the configuration and resistance with the amount of not necessarily same local area of the resistor classified with the electrode 2 for external connection, and the bipolar electrode 3 but the configuration or resistance for a local area was different, the part which the electrical potential difference by which a load is carried out concentrates occurred, and the technical problem that a good withstand voltage property was not acquired occurred.

[0005] This invention aims at offering a resistor with the outstanding withstand voltage property.

[0006]

[Means for Solving the Problem] In order to attain this purpose, the configuration and resistance for a local area of a resistor which were classified with the inter-electrode one for external connection, the bipolar electrode, and the bipolar electrode are made for this invention to

become almost the same.

[0007] Moreover, the configuration and resistance for a local area of a resistor which were classified with the inter-electrode one for external connection, the bipolar electrode, and the bipolar electrode are manufactured so that it may become almost the same.

[0008]

[Embodiment of the Invention] The electrode for external connection by which invention of this invention according to claim 1 was electrically connected to the top face of an insulating substrate and this insulating substrate through the resistor, It has one or more bipolar electrodes prepared in said inter-electrode one for external connection, and the resistor prepared so that it might superimpose said inter-electrode one for external connection. Laser trimming of the part for the local area of said resistor classified between said electrode for external connection and bipolar electrode, and said bipolar electrode is carried out respectively. The configuration and resistance for the local area are the almost same resistor, and it has the operation of the ability to make the part according to each distribute equally the electrical potential difference by which a load is carried out by arranging the configuration and resistance for a local area of a resistor which were classified with the bipolar electrode.

[0009] The process by which invention of this invention according to claim 2 forms [the electrode for external connection, and this inter-electrode one for external connection] one or more bipolar electrodes in the top face of an insulating substrate with the same ingredient at coincidence, The process which forms the resistor prepared so that it might superimpose on said inter-electrode one for external connection, It consists of a process which carries out laser trimming of the part for the local area of said resistor classified between said electrode for external connection and bipolar electrode, and said bipolar electrode respectively. A configuration and resistance are the manufacture approaches of the almost same resistor, and since the configuration and resistance for a local area of a resistor are identities mostly, the amount of [of said resistor by which laser trimming was carried out] local area has an operation that a part for all local areas can be manufactured on the same conditions.

[0010] Invention of this invention according to claim 3 is the manufacture approach of a resistor according to claim 2 of having the process which connects the electrode for external connection, and a bipolar electrode electrically with a lead terminal, and the process made lacking the lead terminal connected to the bipolar electrode among said lead terminals, and has an operation that a bipolar electrode can form easily only by adding the process which makes the production process of a resistor

network with a lead terminal which has three or more electrodes for external connection lack a lead terminal.

[0011] Hereafter, the resistor in a gestalt and its manufacture approach of 1 operation of this invention are explained, referring to a drawing.

[0012] Drawing 1 is the front view of the resistor in the gestalt of 1 operation of this invention. 11 is the insulating substrate of the shape of a rectangle which consists of an alumina, and is the length of 3.3mm, width of face of 6.5mm, and magnitude with a thickness of 0.8mm. 12 is an electrode for external connection which was formed in one insulating-substrate 11 top-face both ends at a time and which uses Ag as a principal component. 13 is the resistor of the ruthenium oxide system formed in insulating-substrate 11 top face so that between the electrodes 12 for external connection might be superimposed. 14 is the bipolar electrode of the same component as the electrode 12 for external connection prepared in insulating-substrate 11 top face so that a resistor 13 might be electrically connected between the electrodes 12 for external connection. the electrode 12 for external connection which these two bipolar electrodes 14 have -- it is designed so that it may be exactly located in the middle. The magnitude for a local area of the resistor 13 classified between the electrode 12 for external connection and the bipolar electrode 14 is about 8 micrometers in the length of 1.2mm, width of face of 1.8mm, and thickness. 15 is the trimming slot of the L character mold formed using laser, in order to correct the resistance of a resistor 13, and it has width of face of about 50 micrometers. Although the magnitude of the trimming slot 15 of a L character mold changes greatly with conditions, such as first resistance, it is referred to as 0.1mm - 0.6mm by the upstream (the direction of a current, and perpendicular direction), and it aims at 0.3mm - 0.6mm by the secondary (the direction of a current). Since the resistance correction of the local area parts of each of the resistor 13 classified between the electrode 12 for external connection and the bipolar electrode 14 is made so that it may become $500\text{k}\Omega \pm 5\%$, between the electrodes 12 for external connection, it has $1\text{M}\Omega \pm 5\%$ resistance. Since the trimming slot 15 is in the local area parts of every one each of the resistor 13 classified between the electrode 12 for external connection, and the bipolar electrode 14, there are two trimming slots 15 between the electrodes 12 for external connection. Since two trimming slots 15 are mostly manufactured on the same conditions, they serve as the almost same configuration and die length. 16 is the lead terminal electrically connected with the electrode 12 for external connection.

[0013] The manufacture approach is explained to drawing 2 about the resistor in the gestalt of 1 operation of this invention constituted as mentioned above.

[0014] First, as are shown in drawing 2 (a), and shown in drawing 2 (b), the electrode 12 for external connection and a bipolar electrode 14 are formed in the fields of each divided in the division slot 18 of insulating-substrate 17 top face of the shape of a sheet equipped with the division slot 18 for dividing into the piece of an individual with the same ingredient with screen printing at coincidence.

[0015] Next, as shown in drawing 2 (c), a resistor 13 is formed with screen printing so that the electrode 12 for external connection in the field divided in the division slot 18 may be superimposed.

[0016] Next, measuring resistance for the resistor between the electrode 12 for external connection, and a bipolar electrode 14, as shown in drawing 2 (d), laser trimming is carried out, the trimming slot 15 is formed, it corrects to desired resistance, and the configuration and resistance for a local area are made almost the same.

[0017] Next, as shown in drawing 2 (e), an insulating substrate 17 is divided along the division slot 18, and the piece 11 of an individual of the insulating substrate which has the resistor 13 with the electrode 12 for external connection, a bipolar electrode 14, and the trimming slot 15 in the top face is obtained.

[0018] Next, as shown in drawing 2 (f), a lead terminal 16 is inserted in the electrode 12 for external connection and bipolar electrode 14 of an insulating substrate 11 used as the piece of an individual.

[0019] Next, as shown in drawing 2 (g), the lead terminal 16 of middle connected to the bipolar electrode 14 in the lead terminal 16 is made missing.

[0020] Finally, the lead terminal 16 of both ends is electrically connected to the electrode 12 for external connection with solder, and a resistor is manufactured.

[0021] The actuation is explained about the resistor in the gestalt of 1 operation of this invention constituted and manufactured as mentioned above.

[0022] Drawing 3 is the circuit diagram of an inverter circuit showing the example of use of the resistor in the gestalt of 1 operation of this invention. 21 and 22 are the resistors for potential detection. 21 or 22 is the resistance beyond 100kohm, it connects with a serial by the potential detecting element 23, and it is arranged between the armature-voltage control section and the inverter generating circuit section. Feedback connection of the potential detecting element 23 is made to the armature-voltage control section.

[0023] 21 and 22 were conventionally constituted from a thin film system resistor which makes a metallic material or carbon, such as NiCr, a subject by electrical resistance materials. In 100V to 700V, a comparatively high load electrical potential difference, high humidity, or

the environment where it is easy to dew, since about 10nm of especially resistor thickness and the very thin resistor beyond resistance 100kohm were electrical resistance materials with the property which oxidizes from the first, resistance increased gradually with time amount progress, and they had the problem on which the potential of the potential detecting element 23 is changed depending on extent of an increment. Then, the approach of using a resistor like drawing 1 which uses oxides, such as ruthenium oxide, as an electrical conducting material for 21 and 22 is increasing.

[0024] It is used for the resistors 21 and 22 of the gestalt of operation of this invention by electrical-potential-difference 500V. Although the electrical potential difference by which a load is generally carried out is concentrated on the outskirts of a trimming slot of a resistor, since the trimming slot 15 is magnitude with almost same those with two piece and each trimming slot 15, it can reduce the electrical potential difference per piece of the trimming slot 15 between lead terminals 16 at the one half of the electrical potential difference by which a load is carried out between lead terminals 16, 250V [i.e.,].

[0025] Generally, if a resistor is used in a high-voltage load and a high humidity environment, the effect of resistance fluctuation etc. will come out in many cases. The property Fig. showing the rate of a change in resistance when carrying out 1000V load for the resistor in the gestalt of 1 operation of this invention and the resistor based on the conventional example continuously for 1000 hours under a high humidity (60-degree-C, 90 - 90%RH) environment, respectively is shown in drawing 4 . It turns out that the change in resistance of the resistor in the gestalt of 1 operation of this invention is very small compared with the conventional example, and improvement in a withstand voltage property can be attained.

[0026] In addition, although the gestalt of 1 operation of this invention explained the case where made missing the terminal of the core of the SIP form resister network of three terminals, and it considered as two terminals, with four or more terminals, the same effectiveness is acquired by making missing the lead terminal of arbitration other than both ends.

[0027] Moreover, also in the case of other approaches [, such as a thin film,], the same effectiveness is acquired although the gestalt of 1 operation of this invention described the case where the electrode for external connection, a bipolar electrode, and a resistor were formed with screen printing.

[0028]

[Effect of the Invention] As mentioned above, according to this invention, by making the same the configuration and resistance of the resistor

divided with the bipolar electrode, since the load which joins each divided resistor can be distributed equally, the improvement in a withstand voltage property can be achieved effectively.

[0029] It is not necessary to change manufacture conditions by the resistor, and improvement in the yield can be aimed at by making especially the configuration and resistance of a resistor the same.

[0030] In the case of the network resistor which connected the lead terminal to three or more electrodes for external connection electrically, originally what is an electrode for external connection can be used now as a bipolar electrode by adding the process made to lack at least one of lead terminals other than both ends, without changing the configuration of a resistor or the electrode for external connection, and the resistor whose withstand voltage property improved can be manufactured easily.

[0031] Moreover, by the resistor by which trimming was carried out, the power by which the load was carried out concentrated around the trimming slot, and became an elevated temperature very much locally, and when power was applied too much, there was a trouble that a resistor will be able to be burned off. However, since the resistor manufactured by this invention has two or more trimming slots in the inter-electrode one for external connection, a power concentration part is spread and the effectiveness that a power-proof property improves is also acquired.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The front view of the resistor in the gestalt of 1 operation of this invention

[Drawing 2] Drawing showing this manufacture approach

[Drawing 3] Drawing showing this example of use

[Drawing 4] The property Fig. showing the change in resistance when carrying out this load test

[Drawing 5] The front view of the conventional resistor

[Description of Notations]

11 Insulating Substrate

12 Electrode for External Connection

13 Resistor

14 Bipolar Electrode

15 Trimming Slot

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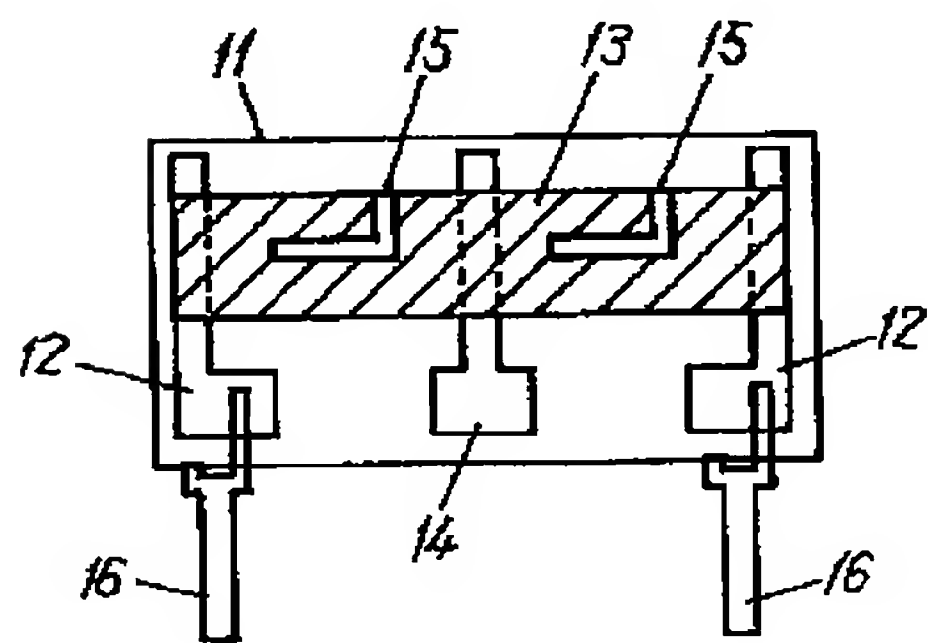
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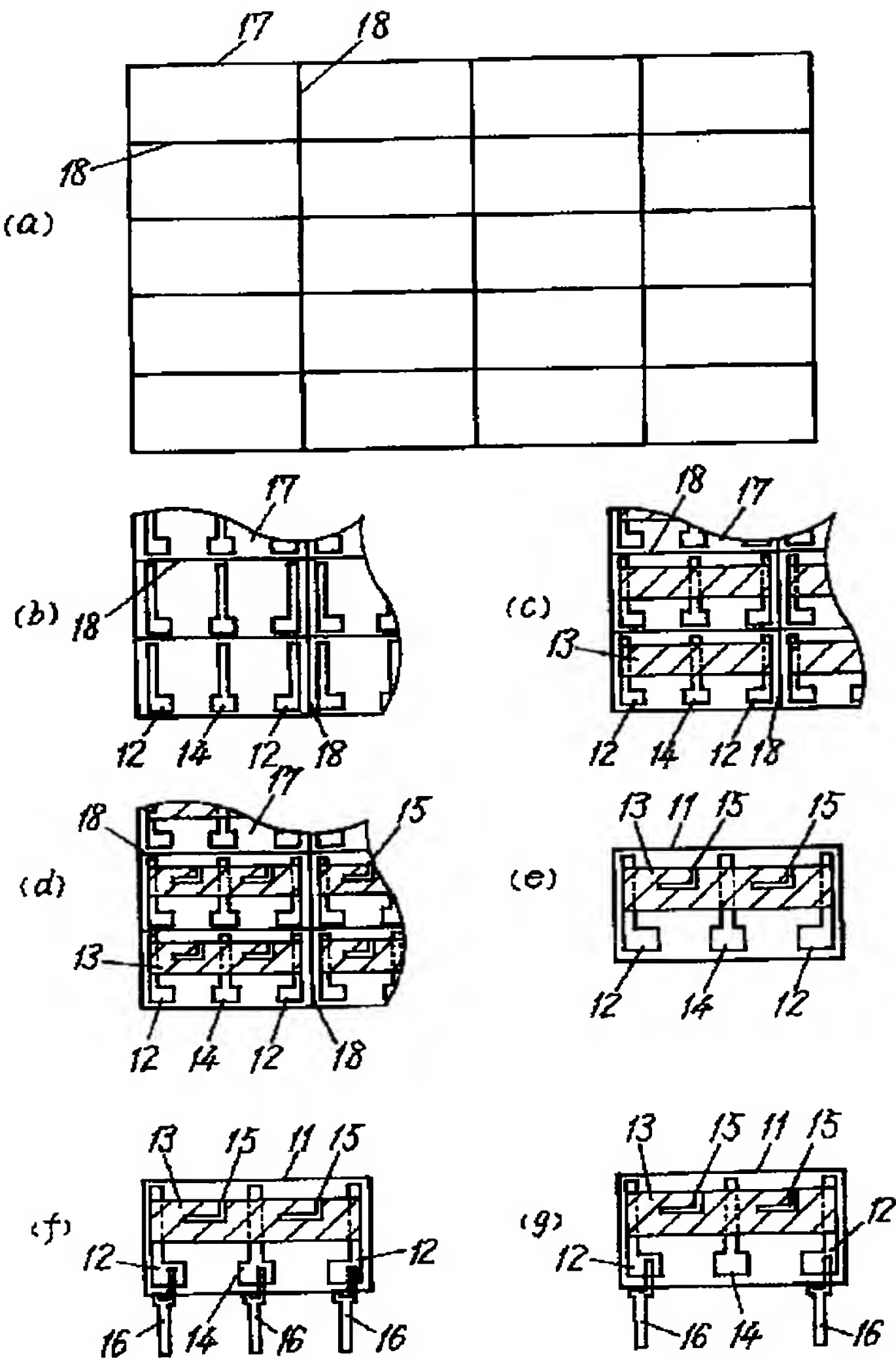
DRAWINGS

[Drawing 1]

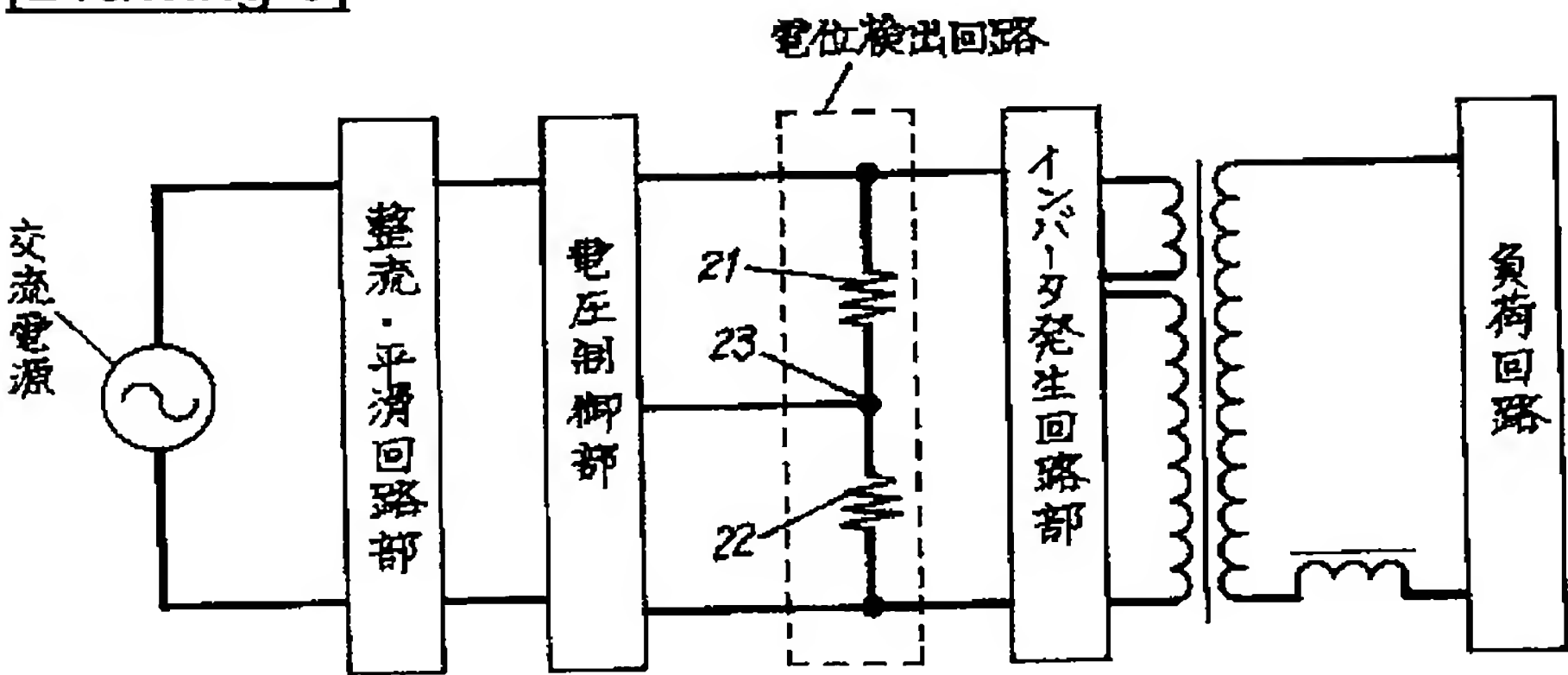
- 11 絶縁基板
- 12 外部接続用電極
- 13 抵抗体
- 14 中間電極
- 15 トリミング溝



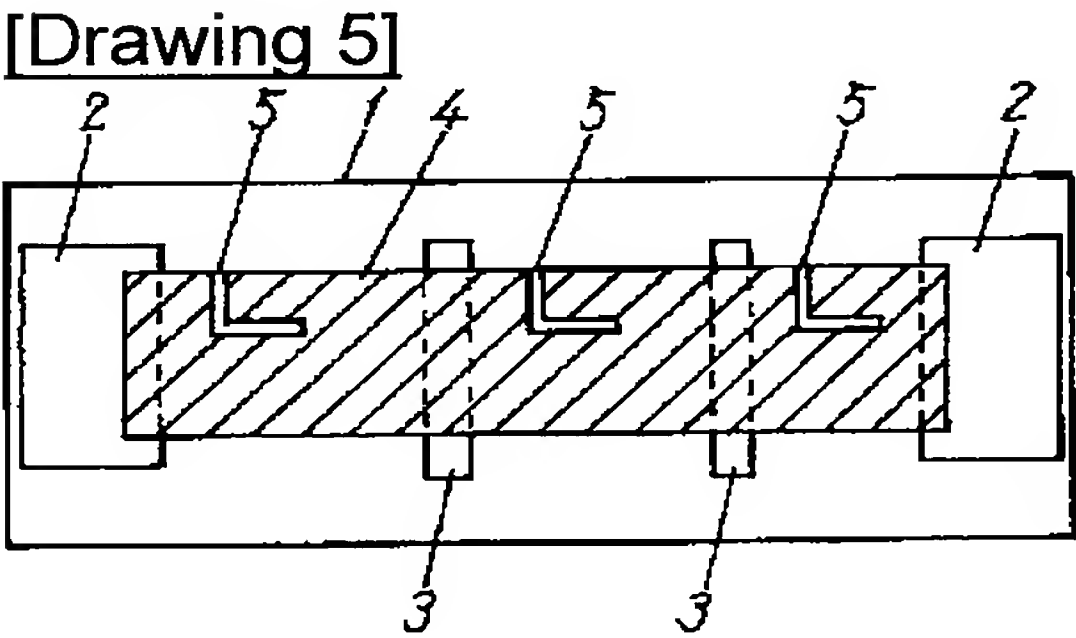
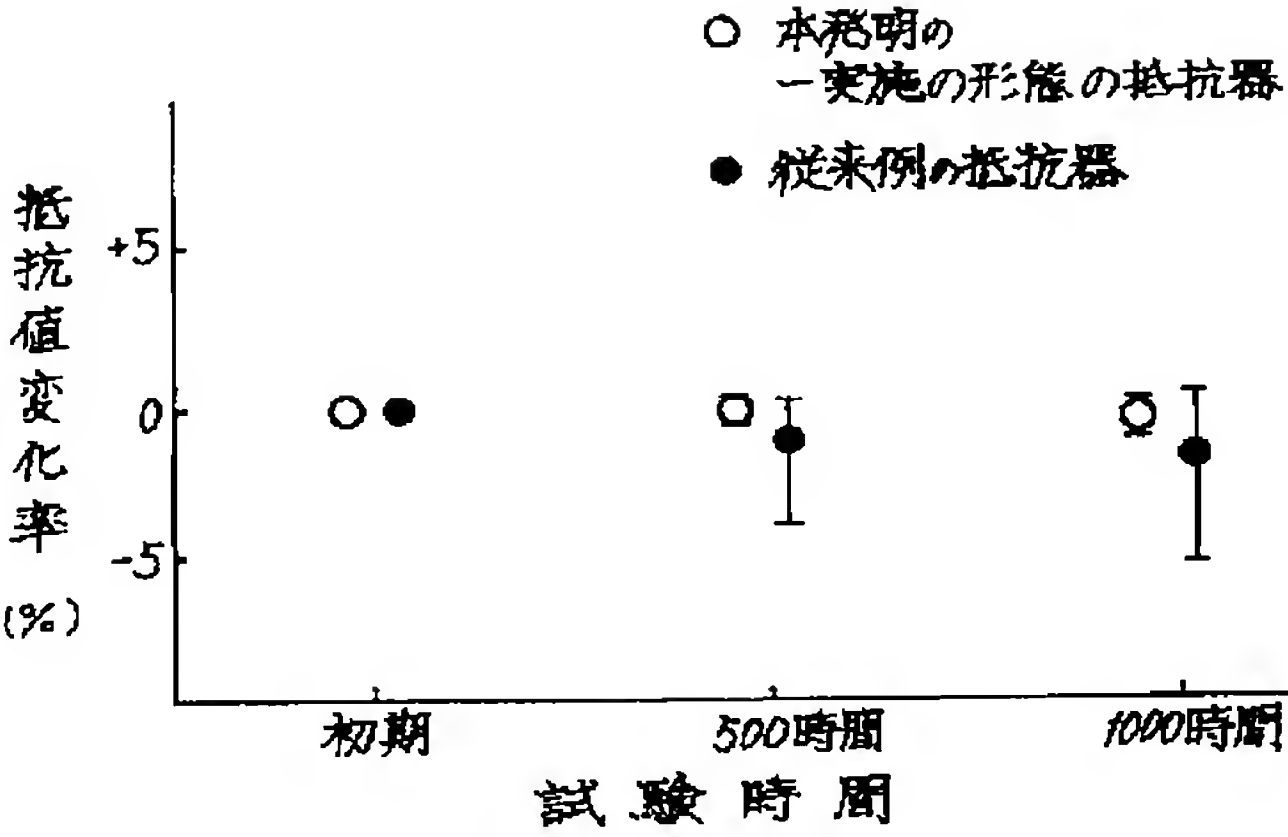
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

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(54)【発明の名称】 抵抗器およびその製造方法

(57)【要約】

【課題】 インバータ回路などで電流検出及び電位検出に使用される抵抗器において、耐電圧特性の向上を目的とする。

【解決手段】 外部接続用電極12と、外部接続用電極12とを重畳するように設けられた抵抗体13と、抵抗体13と外部接続用電極12との間に中間電極14を備え、外部接続用電極12と中間電極14に接続された抵抗体13はほぼ同一形状で、かつトリミングによりほぼ同一の抵抗値に修正されているので、高電圧を負荷したときに抵抗体にかかる電圧が均等に分散でき、効果的に耐電圧特性向上が図れる。

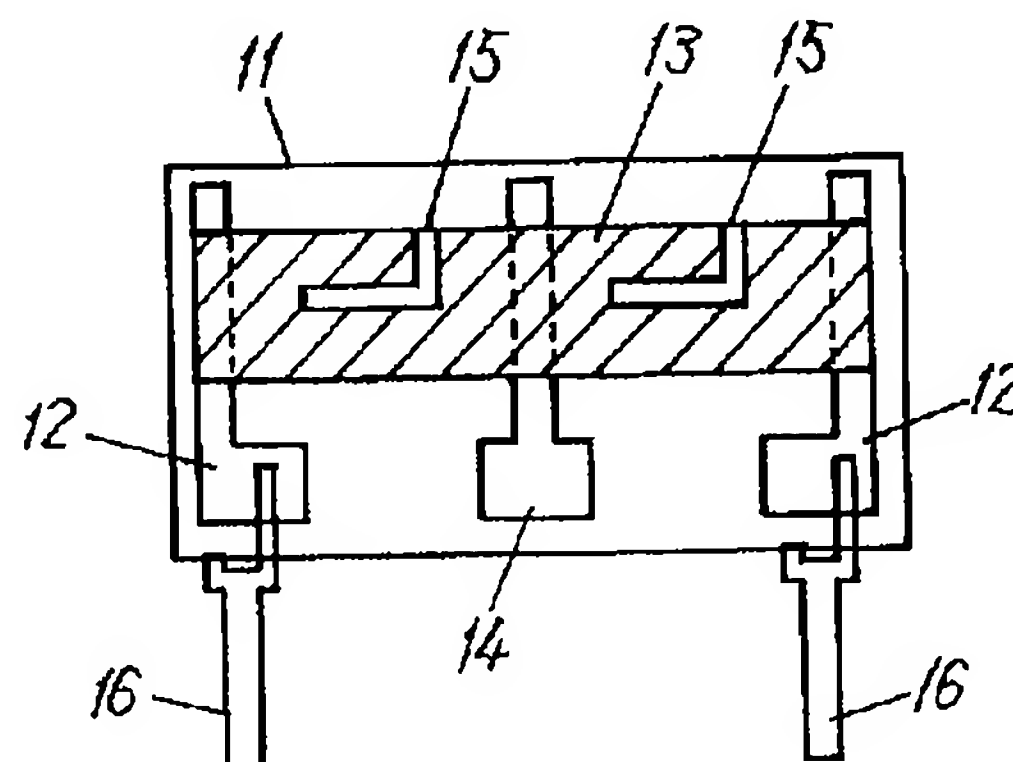
11 絶縁基板

12 外部接続用電極

13 抵抗体

14 中間電極

15 トリミング溝



【特許請求の範囲】

【請求項1】 絶縁基板と、この絶縁基板の上面に抵抗体を介して電氣的に接続された外部接続用電極と、前記外部接続用電極間に設けられた1個以上の中間電極と、前記外部接続用電極間を重畳するように設けられた抵抗体とを備え、前記外部接続用電極と中間電極および前記中間電極間で区分された前記抵抗体の個別部分を各々レーザトリミングし、その個別部分の形状および抵抗値がほぼ同一である抵抗器。

【請求項2】 絶縁基板の上面に外部接続用電極とこの外部接続用電極間に1個以上の中間電極とを同時に同一材料で形成する工程と、前記外部接続用電極間に重畳するように設けられた抵抗体を形成する工程と、前記外部接続用電極と中間電極および前記中間電極間で区分された前記抵抗体の個別部分を各々レーザトリミングする工程とからなり、前記レーザトリミングされた抵抗体の個別部分は形状および抵抗値がほぼ同一である抵抗器の製造方法。

【請求項3】 外部接続用電極と中間電極とをリード端子により電氣的に接続する工程と、前記リード端子のうち中間電極に接続されたリード端子を欠落させる工程とを有する請求項2記載の抵抗器の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、インバータ回路などで電圧検出及び電流検出用に使用される抵抗器およびその製造方法に関するものである。

【0002】

【従来の技術】従来の抵抗器としては、社団法人発明協会発行の公技番号85-1906の公開技報に記載されたものが知られている。

【0003】図5は従来の抵抗器の正面図である。1は基板である。2は基板1の両端に設けられた外部接続用電極である。3は外部接続用電極2間の基板1上面に設けられた中間電極である。4は外部接続用電極2間に設けられた抵抗体である。5は抵抗体4に形成された均一な切込量のトリミング溝である。

【0004】

【発明が解決しようとする課題】しかしながら前記のような抵抗器においては、外部接続用電極2と中間電極3とで区分された抵抗体の個別部分が必ずしも同じ形状および抵抗値にならず、個別部分の形状または抵抗値が異なれば、負荷される電圧が集中する部分が発生し、良好な耐電圧特性が得られないという課題があった。

【0005】本発明は、優れた耐電圧特性をもつ抵抗器を提供することを目的とするものである。

【0006】

【課題を解決するための手段】この目的を達成するために本発明は、外部接続用電極間と中間電極および中間電極により区分された抵抗体の個別部分の形状および抵抗

値をほぼ同一となるようにするものである。

【0007】また、外部接続用電極間と中間電極および中間電極により区分された抵抗体の個別部分の形状および抵抗値をほぼ同一となるように製造するものである。

【0008】

【発明の実施の形態】本発明の請求項1に記載の発明は、絶縁基板と、この絶縁基板の上面に抵抗体を介して電氣的に接続された外部接続用電極と、前記外部接続用電極間に設けられた1個以上の中間電極と、前記外部接続用電極間を重畳するように設けられた抵抗体とを備え、前記外部接続用電極と中間電極および前記中間電極間で区分された前記抵抗体の個別部分を各々レーザトリミングし、その個別部分の形状および抵抗値がほぼ同一である抵抗器であり、中間電極によって区分された抵抗体の個別部分の形状および抵抗値を揃えることで負荷される電圧を各個別部分に均等に分散させることができるという作用を有する。

【0009】本発明の請求項2記載の発明は、絶縁基板の上面に外部接続用電極とこの外部接続用電極間に1個以上の中間電極とを同時に同一材料で形成する工程と、前記外部接続用電極間に重畳するように設けられた抵抗体を形成する工程と、前記外部接続用電極と中間電極および前記中間電極間で区分された前記抵抗体の個別部分を各々レーザトリミングする工程とからなり、前記レーザトリミングされた抵抗体の個別部分は、形状および抵抗値がほぼ同一である抵抗器の製造方法であり、抵抗体の個別部分の形状および抵抗値がほぼ同一なので全ての個別部分を同一条件で製造できるという作用を有する。

【0010】本発明の請求項3記載の発明は、外部接続用電極と中間電極とをリード端子により電氣的に接続する工程と、前記リード端子のうち中間電極に接続されたリード端子を欠落させる工程とを有する請求項2記載の抵抗器の製造方法であり、3個以上の外部接続用電極を有するリード端子付き抵抗ネットワークの製造工程に、リード端子を欠落させる工程を加えるだけで容易に中間電極を形成できるという作用を有する。

【0011】以下、本発明の一実施の形態における抵抗器およびその製造方法について、図面を参照しながら説明する。

【0012】図1は本発明の一実施の形態における抵抗器の正面図である。11はアルミナからなる矩形状の絶縁基板であり、縦3.3mm、幅6.5mm、厚み0.8mmの大きさである。12は絶縁基板11上面両端に1個ずつ形成された、Agを主成分とする外部接続用電極である。13は外部接続用電極12間を重畳するように絶縁基板11上面に形成された酸化ルテニウム系の抵抗体である。14は外部接続用電極12間に抵抗体13を電氣的に接続するように絶縁基板11上面に設けられた、外部接続用電極12と同一成分の中間電極である。この中間電極14は2個ある外部接続用電極12のちょうど中

間に位置するように設計されている。外部接続用電極12と中間電極14の間に区分された抵抗体13の個別部分の大きさは、縦1.2mm、幅1.8mm、厚み約8 μ mである。15は抵抗体13の抵抗値を修正するためにレーザーを使って形成されたL字型のトリミング溝で、およそ50 μ mの幅がある。L字型のトリミング溝15の大きさは初抵抗値などの条件によって大きく異なるが、一次側（電流方向と垂直方向）で0.1mm～0.6mm、二次側（電流方向）で0.3mm～0.6mmを目標としている。外部接続用電極12と中間電極14の間に区分された抵抗体13の個別部分各々を500k Ω ±5%になるように抵抗値修正しているので、外部接続用電極12間では1M Ω ±5%の抵抗値を持つ。トリミング溝15は、外部接続用電極12と中間電極14の間に区分された抵抗体13の個別部分各々に1つずつあるので、外部接続用電極12間には2つのトリミング溝15がある。2個のトリミング溝15はほぼ同一条件で製造されるので、ほとんど同じ形状および長さとなる。16は外部接続用電極12と電氣的に接続されたリード端子である。

【0013】以上のように構成された本発明の一実施の形態における抵抗器について、図2にその製造方法を説明する。

【0014】まず、図2(a)に示すように、個片に分割するための分割溝18を備えたシート状の絶縁基板17上面の分割溝18で区切られた領域各々に、図2(b)に示すように、外部接続用電極12と中間電極14をスクリーン印刷法で同時に同一材料で形成する。

【0015】次に、図2(c)に示すように、分割溝18で区切られた領域内の外部接続用電極12を重畳するように抵抗体13をスクリーン印刷法で形成する。

【0016】次に、図2(d)に示すように、外部接続用電極12と中間電極14の間の抵抗体を、抵抗値を測定しながらレーザートリミングをしてトリミング溝15を形成し、所望の抵抗値に修正して、個別部分の形状と抵抗値をほぼ同一とする。

【0017】次に、図2(e)に示すように、絶縁基板17を分割溝18に沿って分割し、外部接続用電極12、中間電極14およびトリミング溝15を持つ抵抗体13をその上面に持つ絶縁基板の個片11を得る。

【0018】次に、図2(f)に示すように、個片となった絶縁基板11の外部接続用電極12と中間電極14にリード端子16を挿入する。

【0019】次に、図2(g)に示すように、リード端子16の中で中間電極14に接続された真ん中のリード端子16を欠落させる。

【0020】最後に、両端のリード端子16をはんだにより外部接続用電極12と電氣的に接続させて、抵抗器を製造するものである。

【0021】以上のように構成、製造された本発明の一実施の形態における抵抗器についてその動作を説明す

る。

【0022】図3は本発明の一実施の形態における抵抗器の使用例を示すインバータ回路の回路図である。21, 22は電位検出用抵抗器である。21, 22のいずれか一方は100k Ω 以上の抵抗値であり、電位検出部23で直列に接続され、電圧制御部とインバータ発生回路部の間に配置されている。電位検出部23は電圧制御部へ帰還接続されている。

【0023】従来21, 22は抵抗材料にNiCr等の金属材料またはカーボンを主体とする薄膜系抵抗器で構成されていた。100Vから700Vと比較的高い負荷電圧と高湿度や結露しやすい環境において、特に抵抗体膜厚10nm程度と非常に薄い抵抗値100k Ω 以上の抵抗体は、もともと酸化する性質を持つ抵抗材料なので、時間経過に伴い抵抗値が徐々に増加し、増加の程度によっては電位検出部23の電位が変動する問題があった。そこで21, 22に、酸化ルテニウム等の酸化物を導電材料とする図1のような抵抗器を使用する方法が増加している。

【0024】本発明の実施の形態の抵抗器21, 22に電圧500Vで使用する。一般に負荷される電圧は抵抗体のトリミング溝周辺に集中するが、トリミング溝15がリード端子16間に2個あり、かつ各々のトリミング溝15はほとんど同一の大きさなので、トリミング溝15の1個当たりの電圧はリード端子16間に負荷される電圧の半分、つまり250Vに低減できる。

【0025】一般に、高電圧負荷・高湿度環境において抵抗器を使用すると、抵抗値変動などの影響がでることが多い。本発明の一実施の形態における抵抗器と従来例に基づく抵抗器をそれぞれ、高湿度(60℃、90～90%RH)環境下で1000V負荷を連続1000時間したときの抵抗値変化率を表す特性図を図4に示す。本発明の一実施の形態における抵抗器の抵抗値変化が従来例に比べて極めて小さくなっており、耐電圧特性の向上が達成できることがわかる。

【0026】なお、本発明の一実施の形態では、3端子のSIP形抵抗ネットワークの中心の端子を欠落させて2端子とする場合を説明したが、4端子以上では、両端以外の任意のリード端子を欠落させることで、同様の効果が得られる。

【0027】また、本発明の一実施の形態では、スクリーン印刷法によって外部接続用電極や中間電極、抵抗体を形成した場合について述べたが、薄膜など他の方法の場合でも同様の効果が得られる。

【0028】

【発明の効果】以上のように本発明によれば、中間電極によって分割された抵抗体の形状と抵抗値を同一とすることで、分割された抵抗体それぞれに加わる負荷を均等に分散できるので、効果的に耐電圧特性向上を果たすことができる。

【0029】特に抵抗体の形状や抵抗値を同一とすることで、製造条件を抵抗体によって変える必要がなく、歩留まりの向上が図れる。

【0030】リード端子を3個以上の外部接続用電極に電氣的に接続したネットワーク抵抗器の場合、両端以外のリード端子の少なくとも1本を欠落させる工程を加えることで抵抗体や外部接続用電極の形状を変えずに、本来、外部接続用電極であるものを中間電極として使用することができるようになり、耐電圧特性が向上した抵抗器を容易に製造することができる。

【0031】また、トリミングされた抵抗器では負荷された電力がトリミング溝の周辺に集中して局所的に非常に高温になり、電力をかけすぎると抵抗体が焼き切れてしまうという問題点があった。しかし、本発明によって製造された抵抗器は、外部接続用電極間に複数のトリミ

ング溝があるので、電力集中部分が拡散され、耐電力特性が向上するという効果も得られる。

【図面の簡単な説明】

【図1】本発明の一実施の形態における抵抗器の正面図

【図2】同製造方法を示す図

【図3】同使用例を示す図

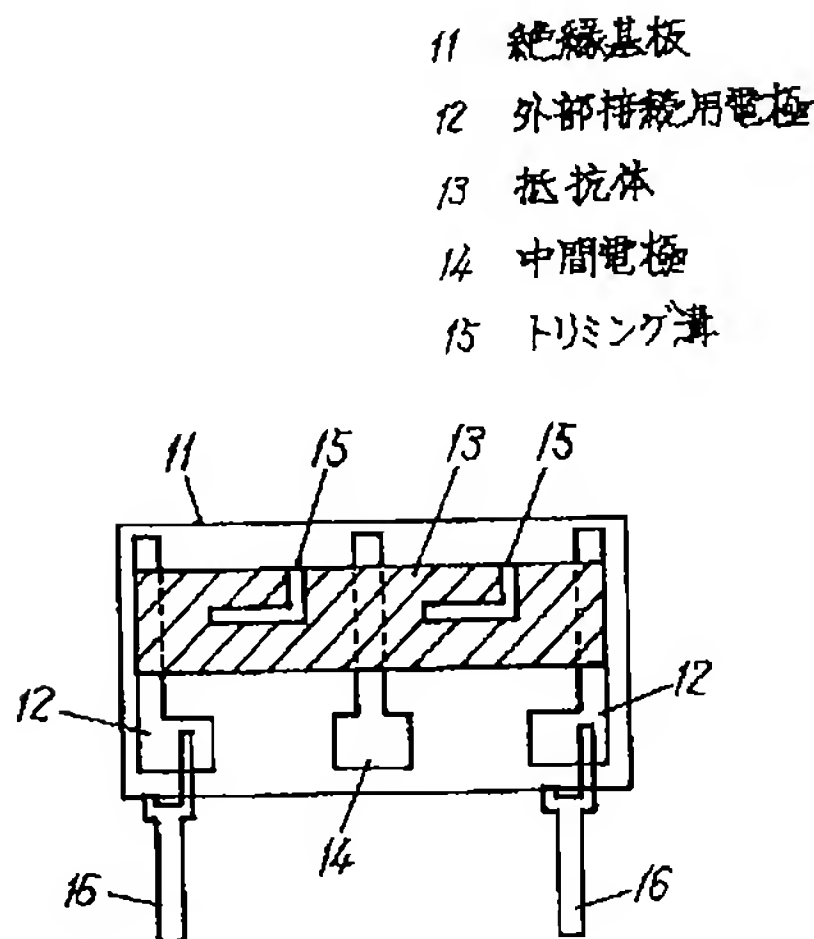
【図4】同負荷試験をしたときの抵抗値変化を示す特性図

【図5】従来の抵抗器の正面図

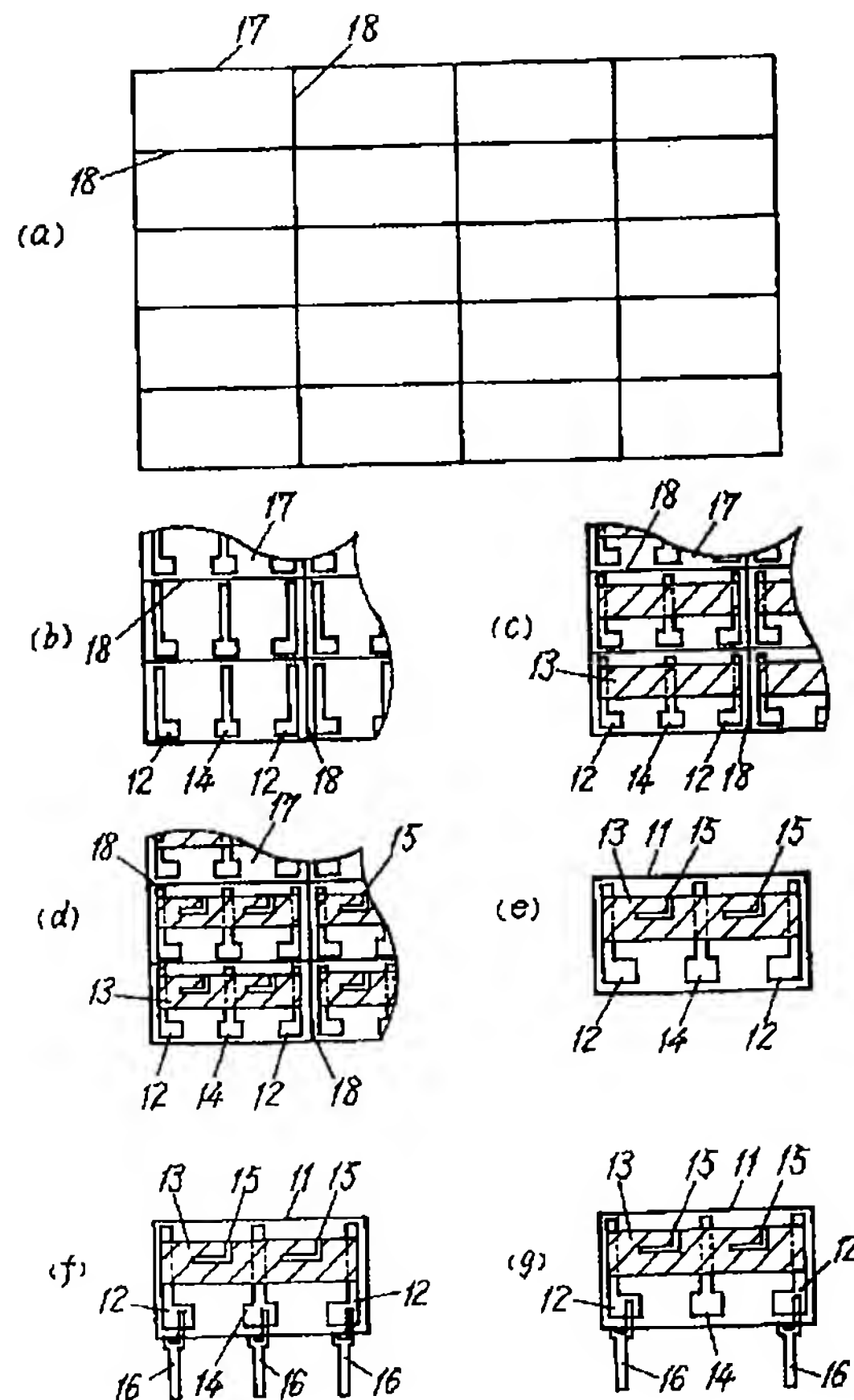
【符号の説明】

- 11 絶縁基板
- 12 外部接続用電極
- 13 抵抗体
- 14 中間電極
- 15 トリミング溝

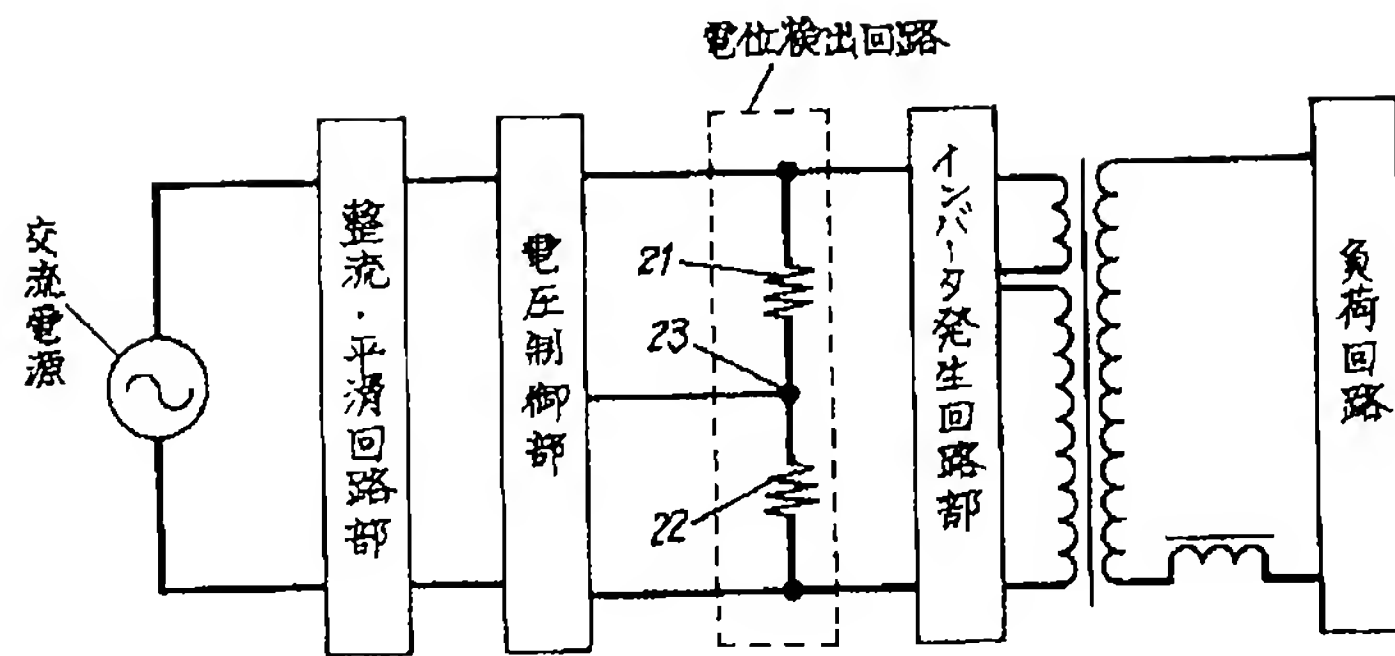
【図1】



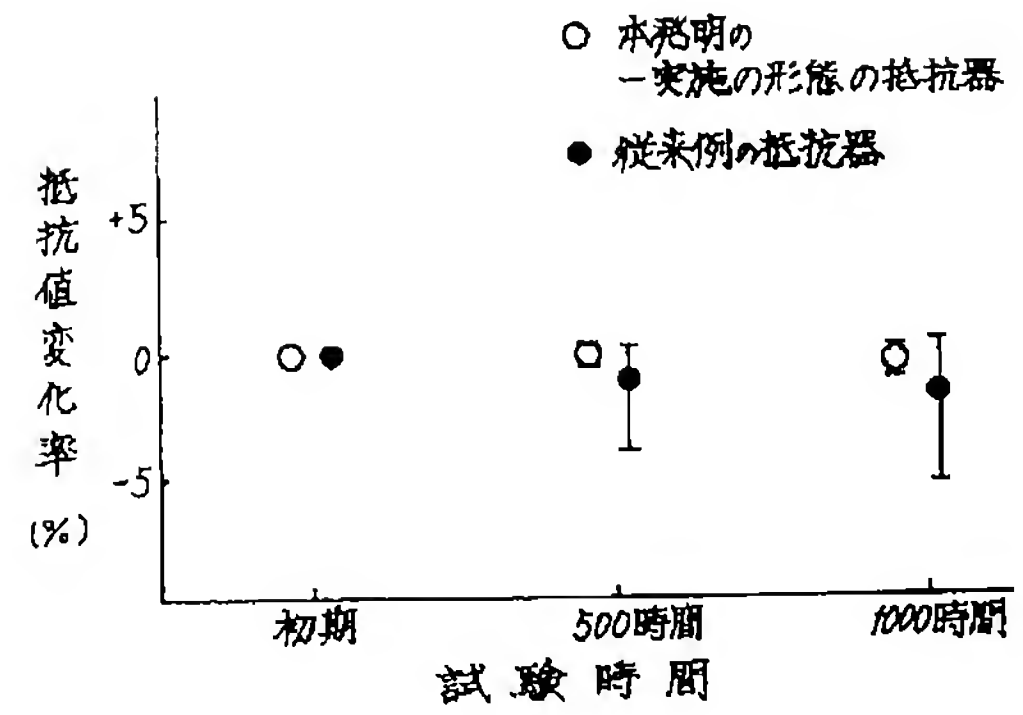
【図2】



【図3】



【図4】



【図5】

